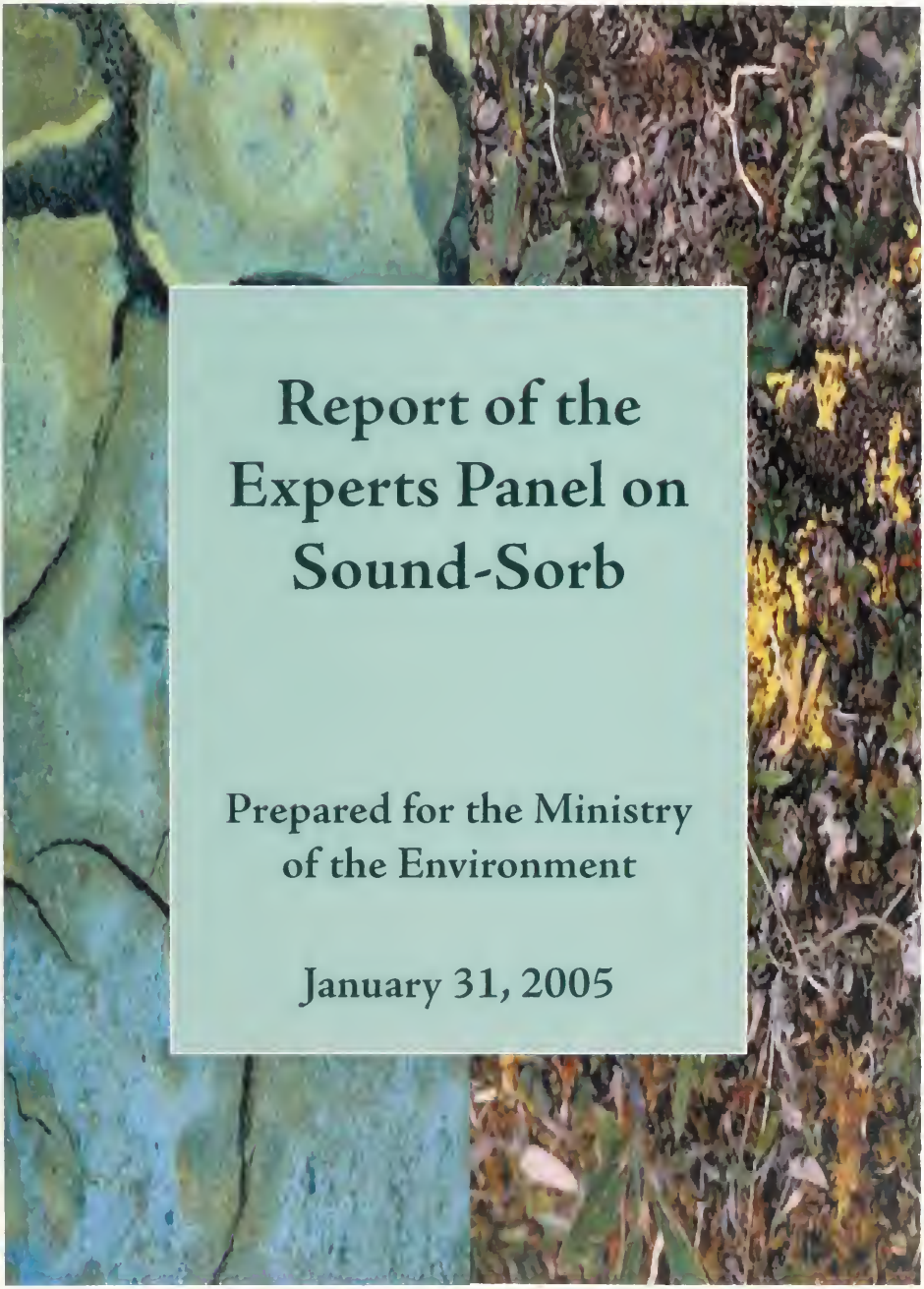

Report of the Experts Panel on Sound-Sorb

Prepared for the Ministry of the Environment

January 31, 2005

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1. Introduction and Background

The Ministry of the Environment established an "independent experts panel" to review the available reports, studies and data on a material called Sound-Sorb to determine if it poses any adverse effects on human health or the environment when used as intended. Sound-Sorb is:

> a product derived from mixing Atlantic Packaging paper fibre biosolids (PFB) and soil at approximately a 3:1 ratio" it is "...used to construct sound and bullet attenuation berms at numerous (8) gun clubs throughout the Province. Sites where Sound-Sorb has been used to construct berms include Oshawa, Madoc, Orillia, Napanee, West Lincoln (2 locations), Aylmer and Peterborough. . . . Paper Fibre Bio-Solids (PFBs) which are used to make Sound - Sorb are municipal waste as that term is broadly defined in Reg. 347. Municipal waste is any waste other than hazardous waste, liquid industrial waste or gaseous waste. PFBs are not hazardous, liquid industrial or gaseous waste and, therefore, are municipal waste. PFBs also fall within the O. Reg. 347 definition of processed organic waste, which is a type of municipal waste. Residents living near these gun clubs and various citizens' groups have raised concern about its use and the potential for the large berms to harm the environment and contaminate groundwater"(EBR, March 2003).

Since December 2001 the Ministry of the Environment (MOE) has pursued a number of studies relating to PFBs and Sound-Sorb. To-date, the ministry's technical review suggests that "there are no adverse environmental impacts resulting from the use of Sound-Sorb as a berm material" (EBR March, 2003). However, some of the affected stakeholders believed that these studies have not answered all of their concerns. As a final step in resolving the concerns regarding Sound-Sorb, the Ministry made the following commitment in its Report on the EBR Application for Review, March, 2003:

> Based on the technical review that the Ministry has undertaken to date and the work that is either ongoing or still to be undertaken, the Ministry proposes to establish an independent panel of scientific expertise to review and assess existing and new data.

1.1 Expert Panel

The Ontario Ministry of the Environment (MOE) established an Expert Panel in February 2004 to provide an "independent-objective-scientific" assessment of the information regarding any adverse effects of Sound-Sorb on human health or the environment. The MOE put three questions to the Expert Panel:

- Does Sound-Sorb have an adverse effect on human health or the environment?
- If yes, to what degree and what mitigation measures, if any, can be instituted to eliminate or minimize the risk to acceptable levels?
- Given the intent to apply the findings across the province, are there any site conditions which may be more sensitive to the use of Sound-Sorb?

The Panel is a technical advisory mechanism to the MOE. It is not a public hearing or complaint review committee. The findings of the Expert Panel will be used by the MOE as an integral part of its decision-making process regarding Sound-Sorb. There was no expectation that the independent Expert Panel will conduct or commission any independent or additional research studies of Sound-Sorb.

1.2 Tier 1 – Tier 2

The Panel consisted of two tiers of participants. Tier 1 was made up of scientists and experts who were asked to render impartial answers to the questions regarding Sound-Sorb. Tier 2 was made up of stakeholders - a cross-section of individuals and organizations who had an interest in the process and the potential outcomes - i.e., the local citizens, Protect the Ridges, Durham Regional Health Unit, Atlantic Packaging, Harvey Ambrose (the developer of Sound-Sorb), Oshawa Skeet and Gun Club, local municipalities, and others. The list of individuals who participated as Tier 1 members can be found in Appendix A. The individuals and organizations who participated as Tier 2 members are listed in Appendix B.

The Tier 1 members had the following roles and responsibilities:

- To review the reports, studies and data on Sound-Sorb in a peer review format and to render a collective answer to the three questions;
- To conduct their own reviews of the literature and bring any relevant research to the attention of their colleagues on the Panel;
- To seek a consensus among themselves and where a consensus was not possible, to represent all differences of opinion in their final report.

The Tier 2 members had the following roles and responsibilities:

- To monitor the Expert Panel workshops to satisfy themselves that the Panel is acting appropriately and meeting the Terms of Reference;
- To participate as observers, to ask for clarification, to offer suggestions and to bring relevant research studies and experience to the attention of the Panel.

Robb Ogilvie, partner with Ogilvie, Ogilvie & Company was retained to serve as the independent facilitator responsible for the integrity of the process, while the experts were responsible for the integrity of their technical analysis and conclusions. Melissa Hirst performed the Secretariat functions for the process and was the recorder for the workshops.

1.3 Workshops

The independent Expert Panel was established in February, 2004 with a mandate to hold four public workshops no later than December, 2004. A Public Information Session was held by the MOE on February 12, 2004. This start-up session with the community was held at the Centennial Centre in Whitby to explain the approach, answer questions and seek their advice and comments.

The MOE plans to hold another public information session after the release of the final report.

The process was designed to be transparent by virtue of stakeholder presence and participation in four workshops. Stakeholders asked questions and raised points for Tier 1 members' consideration. At the same time, the process was informed by the experts in their scientific approach to researching and analyzing the issues and by their hierarchical approach to the development of recommendations. In short, the process and the content were to be dealt with in a manner consistent with the principles of transparency, accountability and objectivity.

The First Workshop was held at the Durham Region Council Chambers in Whitby, Ontario of March 22, 2004. It had three goals:

1. To allow the experts to amend and reach agreement among themselves regarding the draft Terms of Reference.
2. To provide an opportunity for the experts to familiarize themselves with the "binder" of reports and other materials that has been prepared for the Panel's use and deliberations. Ministry staff were on hand to answer any questions regarding these reports.
3. To reach agreement on how the experts want to proceed with their deliberations - i.e., the next steps, what support work would be needed, what would happen between then and the 2nd, 3rd and Final workshops.

As a result of the First Workshop additional reports, studies and guidelines were identified for consideration by the Tier 1 members. The initial list of potential hazards (E. coli, acrylamide monomer, total petroleum hydrocarbons (TPH)) was expanded to include an additional 20 substances or concerns.

The Expert Panel discussed and revised the 3 questions. Question 1 was rephrased to include the quantification of the risk and a description of what the risk is. The word "mitigation" was used in the original Question 2. The Panel members believed monitoring should also be included. Since monitoring is a possible management measure, this term was used to replace the word "mitigation." The Panel felt that it was possible to draw conclusions at a "high level of generalization" that could be applied across the Province. The MOE accepted the changes to the Terms of Reference that were proposed.

The Second Workshop was held at the Centennial Centre in Whitby, Ontario on May 26, 2004. At that workshop:

- The Tier 1 experts reviewed the MOE Orders and supporting documentation with respect to a berm constructed in Flamborough in a wetland.
- The Tier 1 experts reviewed several submissions from Tier 2 members.
- The MOE tabled the results of sampling done at the monitoring wells in October 2003 (Sweep 3).
- The Tier 1 experts asked the MOE about the status of the SSRA being prepared by Cantox Environmental. The draft SSRA was released during the summer on a confidential basis to Tier 1 members to assist their analysis. It was also released to Tier 2 members at the Third

Workshop.

- The Tier 1 members finalized the detailed methodology they planned to use during their summer sessions

The Third Workshop was held at the Durham Region Council Chambers in Whitby, Ontario on October 7, 2004. It had two goals:

- To present the preliminary findings and conclusions of the Tier 1 experts based on their discussions over the summer.
- To answer any questions for clarification and get feedback from the Tier 2 members.

Four preliminary conclusions and the reasons for them were presented:

1. There was no need to remove the berm at the Oshawa Skeet and Gun Club (OSGC).
2. Other existing berms do not require removal prior to assessment.
3. There was no need to ban Sound-Sorb.
4. PFB should be controlled by the MOE throughout its life cycle, with or without admixture with soil.

The Fourth Workshop was held at the Centennial Centre, Whitby, Ontario on December 17, 2004. The purpose of this workshop was:

- To present the final conclusions and recommendations of the Tier 1 experts.
- To provide an opportunity for Tier 2 stakeholders to review and comment on the conclusions and recommendations.

The recommendations at the end of this report are substantially the same as those presented by the Panel on December 17, 2004. One recommendation was split into two. Two of the recommendations were very similar and have been combined into one.

1.4 Final Terms of Reference

Question 1- Does Sound-Sorb, as used as a berm construction material, present a risk to human health or the environment and what is the nature of that risk?

Question 2 - If yes, to what degree and what management measures, if any, can be instituted to eliminate or minimize the risks to acceptable levels?

Question 3 - Given the intent to apply the findings across the Province, under what conditions should Sound-Sorb not be used or its use restricted? "

2.0 Review of the Reports and Literature Relevant to Sound-Sorb

2.1 Screening for Contaminants of Potential Concern

Using a series of half-day sessions and teleconferences from early July until late September, the Expert Panel completed their individual and collective reviews of the literature and reviewed twenty three (23) concerns developed in the First Workshop. These concerns were related to the following conditions or compounds found in, or related to Sound-Sorb, including:

- E. coli
- Acrylamide monomer
- Total Petroleum Hydrocarbons (TPH)
- Temperature
- Polycyclic aromatic Hydrocarbons (PAHs)
- Surfactants – nonylphenol and nonylphenol ethoxylates
- Volatile Organic Compounds (VOCs) (toluene, methyl ethyl ketone (MEK), phenol etc.)
- Bioaerosols
- Metals (copper, lead, silver)
- Nutrients
- Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD)
- Pesticides
- Arsenic
- Formaldehyde
- PCBs
- Compounds likely to be found in inks, dyes, laser jet ink
- Compounds from drinking boxes
- Waxes and wax solvents
- Potential for the berms to be anaerobic
- Potential for leaching and impacts on groundwater and surface water
- Potential impact on fish habitat and aquatic organisms
- Groundwater monitoring wells –construction and monitoring and testing procedures
- Data reliability

The reports that had been generated about Sound-Sorb were made available for review by the Expert Panel. Tier 2 members also received a copy of all reports. The Panel also conducted literature reviews of peer-reviewed publications. The complete list of reports and literature that were reviewed are listed in Appendix E and Appendix F. The reports included studies related to the microbiological analysis of bulk paper fibre biosolids (Atlantic Packaging, 2000; MOE June 2002), sampling events at the Oshawa Skeet and Gun Club (Gartner Lee, 2001; MOE June 2002), a report related to the bioaerosol study conducted at the OSGC (GlobalTox, 2004), summary reports regarding groundwater monitoring studies conducted at the OSGC by the MOE, and a draft SSRA for the OSGC (Cantox, 2004). In addition, some 90 peer reviewed publications were collected following a literature search using keywords related to paper fibre

biosolids (PFB), however, only a selected number of papers were considered relevant to this investigation. Although a systematic review of the peer reviewed literature and summary of that literature is beyond the scope of this report, a summary of the conclusions of the 13 key reports examined by the Expert Panel is provided in Table C.1 in Appendix C of this report. The Panel focused specific attention to the Cantox Environmental draft SSRA. See Table D.1 in Appendix D. The materials provided by Tier 2 members are listed in Appendix G. The Expert Panel also reviewed the results of the Toxicity Characteristic Leach Procedure (TCLP) analysis on the Sound-Sorb material in the berm at the OSGC was done as part of the Cantox Environmental SSRA (October 2004).

2.1.1 Nine Step Methodology

During several sessions in the summer of 2004 the Expert Panel adopted a nine-step methodology to address its Terms of Reference. This methodology entails a stepwise process to examine risks associated with existing berms and new berms. It considers the identification of suspect substances that may be emitted to the environment from the Sound-Sorb mixture, potential concentrations, toxicity, compliance with existing guidelines for groundwater or drinking water, and potential for dispersion to environmental receptors. Those characteristics which depend on Sound-Sorb itself vs. those which depend on site characteristics were also considered in developing a management scheme. The nine steps were:

Step A: Supplement the list of suspect substances /concerns about the contents of Sound-Sorb with a literature review.

Step B: Develop screening criteria/methods to decide what substances can be dropped from further consideration and which ones need further research and evaluation.

Step C: Apply the criteria and determine which substances should have more detailed investigation

Step D: Based on the data/information available, describe the maximum potential loading that could be in Sound-Sorb.

Step E: Extract data from the reports/surveys that describe the measurements found.

Step F: Based on the literature, describe the levels that could potentially occur at/in human or environmental receptors.

Step G: Review as a team and see if there is a consensus that "we see something".

Step H: Compare "G" with the appropriate standards, guidelines, thresholds or effects-based reference criteria (for soil, surface water, groundwater or air).

Step I: Integrate the results of the draft SSRA into the Panel's analysis.

2.2 Management Measures to Reduce Risk

Sound-Sorb is a trade-marked construction material composed of PFBs and mineral soil. It has been used to construct berms at gun clubs in Ontario and is exempt from Ontario's waste management regulation O. Reg. 347.3, Section (2)1. As an exempt material Sound-Sorb has not been subject to MOE control. It has been described as 70 percent PFB and 30 percent sand/mineral soil, but some variation in this ratio does occur. The Expert Panel could not determine to what extent the material was thoroughly mixed. Under the regulatory exemption the material could legally contain municipal, hazardous or liquid industrial waste. Although there was concern from some Tier 2 members that such materials had been put into berms the Expert Panel did not have any verifiable evidence that other materials had been used in berm construction. The samples taken by the MOE from the OSGC berm and other berms appear to be the same material as the raw PFB from Atlantic Packing that the MOE analysed.

There has not been sufficient time for slower moving leachate chemicals from the OSGC berm to reach the monitoring wells. The monitoring well results therefore do not provide evidence for or against wastes other than PFBs being used in the construction of the berm. The Expert Panel was not set up to determine what materials might or might not have been used in berm construction. The data that was available to the panel allowed it to come to conclusions only with respect to the use of PFBs in berms mixed with clean mineral soil.

The Expert Panel felt that it could not come to a conclusion on all of the possible risks to human health and the environment based on the data it had. It also felt that a more systematic collection of data at berms would not provide sufficient additional information to assess future risks. Much of this risk relates to the decomposition of the PFB over decades and possible contamination of the soil on which the berms have been built. On the other hand the Expert Panel believed that the bulk use of PFB in berms could be managed in a way that would reduce any risk to human health and the environment to a minimum.

2.2.1 Removing the exemption on Sound-Sorb

The Expert Panel is recommending that the bulk use of PFBs be handled under MOE Certificates of Approval for all steps of its life-cycle or by other legal instruments that can provide equal or better protection for both human health and the environment. The product formulation exemption should not be applied to Sound-Sorb. This measure would ensure that the conclusions based on the data available would be accurate for future berms.

2.2.2 Pre-composting of PFBs.

This measure would:

- kill potential pathogens like E. coli
- reduce the load of TPHs
- reduce temperature in a newly constructed berm so as to permit immediate vegetative

growth on the berm;

- improve the C:N ratio in the PFBs that would assist vegetative growth;
- reduce slumpage of the berm material.

2.2.3 Requiring monitoring wells for the life of existing berm.

The Expert Panel did not have data that would indicate that the Sound-Sorb that was analysed contained anything other than PFBs and sand/mineral soil material. The Panel recognized that other materials could be in the existing berms. It did not have a mandate under its Terms of Reference to attempt to determine what else might be in a berm. Under the management algorithm that was developed the MOE could require, based on its own investigations, monitoring for other substances for which evidence exists.

2.2.4 Setting Standards for the Siting, Construction and Maintenance of Berms

These measures would be set out in a Certificate of Approval would control the risk of runoff from berms entering surface waters and the risk of bioaerosols coming from berms.

2.2.5. Short Listing of Parameters for Further Consideration

The Expert Panel considered 8 of the parameters for further consideration, including: acrylamide monomer, total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), copper, lead and arsenic, MEK and phenol. The other concerns were addressed as follows:

E. coli had been identified in the PFBs and a puddle on the OSGC site. (Gartner Lee 2001, MOE June 2002, MOE August 2003, MOE April 2004). The source and the pathogenicity of the E. coli could not be conclusively determined. The Expert Panel believed proper composting would control possible hazards related to pathogenic organisms in the material.

Temperature- The concern with respect to temperature related to the heat generated by raw PFBs when it is stored in bulk. This heat had prevented the growth of vegetation on the berms during the first season after they were constructed. The Expert panel believed that proper composting over a year would allow sufficient time for the heat to dissipate from the piles of Sound-Sorb.

Surfactants such as nonylphenol and nonylphenol ethoxylates- These compounds were measured in raw PFBs and leachate and not detected. (Gartner Lee 2001, MOE June 2002). In addition, the Expert Panel believed that any concentrations of these compounds would be subject to biodegradation and that when subjected to aerobic conditions through proper composting, that these compounds would not be persistent. This is supported by several studies conducted on the persistence of nonylphenols in soil (Wild and Jones, 1992: Maguire, 1999).

VOCs- The MOE included VOC scans in its analyses related to Sound Sorb. These analyses showed that these parameters all fell within the soil and groundwater standards provided by the MOE (MOE April 2004). The decomposition of PFBs is likely to generate higher concentrations of phenol than are found in the raw PFBs. The Expert Panel felt that the MOE should conduct sampling of the monitoring wells for phenol on a research basis. See Section 3.2 for more information on this parameter.

Bioaerosols- Although PFBs support the growth of bacteria and moulds, covering the berms with properly composted material or other organic material in addition to a vegetative cover would prevent the PFBs from being a source of hazardous bioaerosols. The Expert Panel agreed with the conclusions of the Sporometrics Bioaerosol study that was part of the GlobalTox report that the potential for bioaerosol generation from Sound-Sorb was low (GlobalTox 2004). The fungal and bacterial organisms generated from Sound-Sorb were typical organisms found in soil. There were no criteria to which concentrations of specific organisms determined by air monitoring could be compared and therefore an air monitoring study was not recommended.

Silver- Although this metal may pose a hazard to ecological receptors, it was not found above guidelines in any of the analyses conducted at the Oshawa Skeet and Gun Club (Cantox 2004).

Nutrients- The PFBs in Sound-Sorb contain a very high carbon to nitrogen ratio. PFBs have a low phoshate content. As such they are not a significant sources of nitrogen and phosphate nutrients that cause the eutrophication of aquatic ecosystems. When the berm is covered with compost and the compost is vegetated, the structure does not represent a major source of these nutrients in comparison to other organic containing soils.

Pesticides- The Expert Panel agreed with the draft SSRA that the most likely source for the pesticides detected (at the detection limit) was agricultural and /or residential use. There should be minimal pesticide residues in the municipal waste paper (MOE August 2003; MOE April 2004; Cantox 2004).

Formaldehyde- This compound was not detected in significant concentrations in the analyses that were conducted by the MOE (MOE January 2004).

PCBs- PCBs were detected at very low concentrations (MOE June 2002; MOE August 2003; MOE April 2004), and it is expected that there would be very minimal concentrations of PCBs in municipal waste paper. In addition, removing the exemption on Sound-Sorb eliminates this concern for future berms.

Compounds likely to be found in inks, dyes, laser jet ink, compounds from drinking boxes and waxes and wax solvents- These compounds are known or may be found in municipal paper waste streams. It is thought that some of these constituents may have contributed to levels of TPH in the raw PFBs in excess of Table 1 and 2 site standards listed under O. Reg. 153/04. Those compounds likely to be present in more than minute amounts are covered by the organic scans that the MOE did.

Anaerobic Decomposition, Leaching- The Expert Panel believed that there was a significant risk that the berms would undergo anaerobic decomposition and generate an acid leachate. The risks to surface waters can be controlled by the selection of an appropriate site, proper construction techniques, and general and specific maintenance measures recommended by the Expert Panel.

BOD- The risk associated with groundwater entering surface water can be monitored by measuring BOD in groundwater.

Monitoring Wells- It was not within the scope of the Terms of Reference of the Expert Panel to address all the concerns that Tier 2 members had with respect to the monitoring wells. In general the Panel believes that the data from the OSGC wells, because of the impermeability of the soil represents baseline conditions rather than significant leachate that has already reached groundwater.

Data Reliability- The Expert Panel concluded that the data provided a reasonable characterization of contaminants in the raw PFBs. The Panel felt that the data from monitoring wells was not representative of leachate that could come from the berms over many decades, both because there was not sufficient time for many contaminants to have migrated to the monitoring wells and because the chemistry inside the berm undergoes significant changes over time.

The Expert Panel therefore retained acrylamide, TPH, PAHs, copper, lead and arsenic, MEK and phenol for further consideration.

2.3 Chemicals Requiring Further Evaluation

One of the first steps in a human health or ecological risk assessment is to screen for potential contaminants of concern that require further assessment. Typically this is accomplished by comparing measured environmental concentration data to generic criteria, standards, or other suitable guideline values that are published by recognized regulatory jurisdictions, such as MOE (MOE, 2004) or U.S. EPA (U.S. EPA, 2004). The Ontario Ministry of the Environment provides Soil Standards (formerly referred to as generic criteria) for the purposes of accessing chemical concentrations in soil for clean-up purposes with the consideration of various land uses for contaminated sites in Ontario. The MOE's Table 2 (O. Reg. 153/04) (formerly Table A) values have been developed to provide protection against the potential for adverse effects to human health, ecological health and the natural environment on sites which are not considered environmentally sensitive. While no specific criteria have been developed for Sound-Sorb *per se*, the soil standards (formerly generic criteria) developed by MOE under Part XV.1 of the *Environmental Protection Act* are somewhat applicable for use in screening chemicals of potential concern from requiring further assessment.

Table 2.3.1 outlines the chemicals that were considered by the Expert Panel as requiring further investigation.

Table 2.3.1 Chemicals for Further Investigation Detected in Sound-Sorb Berm.

Parameter	CCME Guidelines	O. Reg. 153/04 (µg/g) or MOE 1996	Range of Values (µg/g)	2 x Max. Conc. Detected (µg/g)	Component Values (MOE, 2004); other criteria (µg/g)	Requires further investigation
Acrylamide monomer	Na	Na	0.00036	7.2e-4	U.S. EPA Region 9 have developed a PRG of 0.11 µg/g for soil.	No, however, there is no criteria available for ecological receptors. Therefore, acrylamide is discussed further.
TPH	Refer to MOE, 2004 (O. Reg. 153/04)	Compared to MOE 1996 criteria. gas/diesel: 100 heavy oils:1000	3400	6.8×10^3	100 (g/d) 100 (h oil)	Exceeds the MOE's 1996 guidelines, therefore, TPH requires additional investigation
B[a]P	1.2 µg/g in soil;	0.1[a] 0.7[b];	0.080 µg/g in soil;	0.16 µg/g in soil;	1.2 µg/g in soil;	Below the criteria considered to be protective of human health and ecological receptors for soil.
Lead	140 µg/g	200 µg/g	8.9 to 30	60 µg/g	200 µg/g	Not a concern to human receptors as a result of direct contact pathways, however, there is a potential for mobilization and leaching into groundwater
Arsenic	12 µg/g	20 µg/g	nd	nd	20 µg/g	Not detected on-Site.

[a]Agricultural Land Use (CCME, 2003)
[b]Residential Land Use (CCME, 2003)
[c]Agricultural Land Use, Potable water condition (MOE, 2004)
[d]Residential Land Use, potable water condition (MOE, 2004)
[1]Criteria from U.S. EPA Region 9 (2002)

Table 2.3.2 Chemicals for Further Investigation Detected in Groundwater

Parameter	CCME Guidelines	O. Reg. 153/04	Range of Values (µg/L)	2 x Max. Conc. Detected	Component Values (MOE, 2004)	Requires further investigation
Acrylamide monomer	na	Na	0.3 µg/L in gw	0.6 µg/L	0.015 µg/L in tap water[1].	Retained as
Benzo[a]pyrene		0.01 µg/L	0.046 to 0.440 µg/L	exceeds criteria	0.01 µg/L	Exceeds MOE Table A groundwater standards (ODWQS), therefore, it is retained for further investigation.
Copper	2-4 µg/L	23 µg/L	5-7 µg/L from TCLP study	10-14 µg/L	MOE Table 2 criteria (PWQO) = 23 µg/L	Not retained for further assessment

It should be noted that arsenic levels had been reported to be elevated above O. Reg. 153/04 criteria in error in the Gartner Lee (2001) report. The concentration recorded, following review

of the laboratory certificates, was the record applied to barium. Therefore, arsenic was not detected in PFBs at the OSGC site. Copper was not a concern for human health and did not pose a risk to aquatic environment under the management measures recommended. From the screening-level assessment, only total petroleum hydrocarbons, PAHs and lead were retained as Contaminants of Potential Concern (COPC) for monitoring. Acrylamide, MEK and phenol were considered to require further research by the MOE. See Section 3.2.

3.0 Analysis and Conclusions about the Risks

3.1 Toxicity and Existing Guidelines

In support of the final suite of chemicals to be monitored, The Expert Panel used toxicity summaries or guidelines for each of the chemicals or parameters of concern to answer the question, why are these substances chosen for monitoring? What is the value of monitoring?

3.1.1. Lead

The historical use of lead bullets and shot at gun clubs has left behind elevated concentrations of the metal in the soil associated with shooting ranges. Estimates of lead concentrations in soils at such sites in Florida ranged from 880 to 55,000 mg kg^{-1} in one study (Cao et al 2003), whereas 200 mg kg^{-1} is the MOE's Soil Standard for contaminated soils (MOE 2004). In general, lead in soils is considered to be relatively immobile, especially in soils with neutral to alkaline pH values. However, a number of research studies have shown that lead can be mobilized in the presence of organic colloids and that lead-organic complexes can account for large cumulative losses of lead from surface soils. Because of the large quantities of organic material in berms constructed with Sound-Sorb, there is a potential for lead to be mobilized. Therefore concentrations of soluble lead should be measured in the monitoring wells associated with berms constructed with Sound-Sorb at gun clubs to ensure that the metal does not become an environmental concern in areas outside the gun club and berm site.

3.1.2 Benzo[a]pyrene (signature chemical for PAHs)

Benzo[a]pyrene (B[a]P) is a polycyclic aromatic hydrocarbon (PAH) primarily derived from incomplete combustion of fossil fuels. It has been identified in ambient air, surface water, drinking water, waste water, and char-broiled foods (e.g., hamburgers) (IARC, 1983).

B[a]P is readily absorbed following inhalation, oral, and dermal routes of administration (ATSDR 1990) and is rapidly distributed to several tissues in rats. There is very little data available concerning the systemic (i.e., non-carcinogenic) effects of B[a]P following administration in humans, and neither a tolerable daily intake (TDI / RfC) or a reference concentration (TC/ RfC) has been derived for B[a]P.

Numerous epidemiologic studies have shown a clear association between exposure to various mixtures of PAHs containing B[a]P (e.g., coke oven emissions, roofing tar emissions, and cigarette smoke) and increased risk of lung cancer and other tumors, although it is difficult to separate the independent carcinogenic effect of B[a]P from the carcinogenicity of PAH mixtures (IARC 1983). A suitable data base is available concerning the carcinogenicity of B[a]P in experimental animals. Dietary administration of B[a]P has produced papillomas and carcinomas of the forestomach in mice (Neal and Rigdon, 1967). Exposure by inhalation has resulted in benign and malignant tumors of the respiratory and upper digestive tracts of experimental

animals (Thyssen et al 1981). Numerous topical application studies have shown that B[a]P induces skin tumors in several species, although mice appear to be the most sensitive species.

Consistent with Health Canada policies, B[a]P is considered to be a Group II carcinogen. This designation means that there is evidence that it is probably carcinogenic to humans. Health Canada has assigned inhalation and oral cancer slope factors to be used in risk assessments.

The Expert Panel noted the presence of PAHs in the MOE sampling of the monitoring wells in March and May 2003 (Sweeps 1 and 2). Although these PAHs did not likely come from the berm, PAHs are present in the raw PFBs and have very low permissible levels in drinking water under the Ontario Drinking Water Standards (ODWS). B(a)P was therefore included in the monitoring program. Sweeps 1 and 2 by the MOE found levels of seven different PAHs in excess of Table 2 guidelines. The draft SSRA did not retain PAHs as a COPC because they were not detected in Sweep 3 (October 2003; filtered samples) or in drinking water wells. The Panel felt that PAHs should be included in on-going monitoring programs.

3.1.3 Total Petroleum Hydrocarbons

Total Petroleum Hydrocarbons (TPHs) describe a mixture of organic compounds found in or derived from oil, bitumen and coal. Petroleum products are also in gasoline, heating and lubricating oils. They are characterized by the number of carbons in the compound; gas and diesel usually contain less than 24 carbons, and heavy oils more than 24 carbons. The toxicity of each compound depends on carbon number. Small molecular weight hydrocarbons are of concern because they are highly mobile in soil. However, they are readily biodegradable by naturally present soil bacteria. Higher carbon chain oils, however, are not as mobile but tend to persist once released to the environment. The concern is related to their persistence in the environment, and their potential to reach human receptors or other ecological receptors through various pathways of exposure.

The CCME has developed Canada-Wide Standards for petroleum hydrocarbons in soil for various land uses. The CCME methodology is based on the fractionation of TPH into four distinct fractions (F1 to F4 corresponding to -- 6-10 carbons, 11-16 carbons, 17-34 carbons and higher than 34 carbons). The generic screening-level criteria developed by the CCME for protection of human health have been adopted by MOE (2004). The CCME's User Guidance manual (CCME, 2001) provides these criteria. For example, for the F3 and F4 fractions, the component values considered to be protective of human health following direct contact pathways such as ingestion are reported to be 18,000 µg/g and 25,000 µg/g, respectively.

The PFB used in Sound-Sorb contains TPH. Testing for TPH is recommended since TPH is present in the PFB at amounts that exceed Table 1 and 2 guidelines and since TPH can act as an indicator of the possible presence of organic contaminants that could be a concern but are not being monitored. The Expert Panel reviewed the analysis of the hydrocarbons contained in some samples of the PFB and determined that they were similar to a degraded oil mixture and easily capable of being degraded further to levels below guidelines. The most toxic compounds of TPHs are usually the PAHs and these were well below concern levels in the PFB samples tested by the MOE.

3.1.4 Acrylamide

Acrylamide is a chemical that is used in the manufacture of plastics, synthetic rubber, and several types of polyacrylamide copolymers. Based on limited human data and more extensive animal studies of acrylamide exposure, acrylamide has neurotoxic, genotoxic and reproductive health effects. Neurotoxicity appears to be the most sensitive endpoint. Using animal data, a NOAEL for neurotoxicity of 0.5 mg/kg/day has been set (FAO/WHO, 2002; ECB, 2002).

Acrylamide is a known animal carcinogen. However, there have not been sufficient studies in human populations to determine whether it is considered to be a human carcinogen. Acrylamide is produced in foods that are baked or fried, most likely as a reaction between the amino acid asparagine and natural sugars at high temperatures. Because dietary intake cannot be easily measured it is difficult to compare exposure to acrylamide in epidemiological studies with differences in outcome in terms of cancers.

Polyacrylamide is used in some jurisdictions in the treatment of drinking water and wastewater. This use of polyacrylamide results in the potential for human exposure to acrylamide through ingestion of drinking water. In the WHO's Guidelines for Drinking Water Quality (3rd edition, 2004), the guideline value for acrylamide is listed at 0.5 micrograms per litre[1]. In the United States, there is an enforceable maximum contaminant level standard for acrylamide in drinking water. Specifically, The United States Environmental Protection Agency requires that the operators of water treatment systems that use acrylamide must certify that the polyacrylamide used contains no more than 0.05% acrylamide monomer when it is added at a dose of 1 mg/L or equivalent dose, (see www.epa.gov/safewater/index.html). There are no Canadian drinking water criteria for acrylamide. Region 9 of the United States Environmental Protection Office has set a provisional guideline of 0.015 micrograms/L (U.S. EPA Region 9, 2002).

3.1.5 Methyl Ethyl Ketone

Methyl ethyl ketone (MEK), also known as 2-butanone, butanone, or methyl acetone, is used as a solvent in the application of protective coatings (varnishes) and adhesives (glues and cements), in magnetic tape production, in the de-waxing of lubricating oil, in vinyl film manufacture, and in food processing. MEK has been detected as a natural component of numerous foods, including: raw chicken breast, milk, nuts, cheese (e.g., Beaufort, Gruyere, and cheddar), bread dough and nectarines at concentrations ranging from 0.3 to 19 μg/g (ATSDR, 1992 and WHO, 1992). MEK is also found in tobacco smoke and volatile releases from building materials and consumer products (ATSDR, 1992).

An occupational study reported by the World Health Organization indicate that of 51 Italian workers chronically exposed to MEK, exposure was associated with slight, but not statistically significant, reduced nerve conduction velocities and other symptoms such as: headache, loss of appetite and weight, gastrointestinal upset, dizziness, dermatitis, and muscular hypotrophy,

[1] The WHO indicates that this represents the concentration in drinking water associated with an upper bound excess lifetime cancer risk if 10^{-5} or one additional cancer per 100,000 of the population ingesting drinking water containing acrylamide at the guideline value for 70 years. The WHO also notes that this represents a rough estimate of risk, which is based on a hypothetical, mathematical model, albeit a conservative one.

however, no clinically recognizable neuropathy was cited (Freddi et al., 1982 cited in WHO, 1992).

The epidemiologic studies from which one could draw conclusions about carcinogenic risks in the human population are currently inconclusive with respect to exposure to MEK (U.S. EPA, 2003). Thus under EPA's draft revised cancer guidelines (U.S. EPA, 1999), "*data are inadequate for an assessment of human carcinogenic potential*" for MEK. However, it is noted that MEK has not been tested for carcinogenicity in animals by the oral or inhalation routes. Animal studies are available and have been used to set regulatory guidance values, including an RfD and RfC value for MEK. These values are available at U.S. EPA IRIS website located at www.epa.gov/IRIS.

The potential for MEK to be generated from the berms was a concern for the community. There is currently no reliable detection method available to characterize potential exposure to MEK. The Expert Panel felt that the MOE should develop such methods. See Section 3.2.

3.1.6 Phenol

Phenol is a mono-substituted aromatic hydrocarbon, produced from both natural and anthropogenic processes, and is naturally occurring in some foods, human and animal wastes, decomposing organic material, and is produced within the human gut from the metabolism of aromatic amino acids. Currently, the largest use of phenol is as an intermediate in the production of phenolic resins, which are used in the plywood, adhesive, construction, automotive, and appliance industries. Because of its anesthetic effects, phenol is also used in medicines such as ointments, ear and nose drops, cold sore lotions, throat lozenges and sprays (e.g., over the counter sprays such as Cepastat® and Chloraseptic® labels), and antiseptic lotions (U.S. EPA, 2002), therefore low-dose human exposure to phenol would not be completely unexpected.

The U.S. EPA recently re-evaluated phenol (U.S. EPA, 2002) and has determined that the human and animal data from carcinogenicity studies is inadequate for use in determining a toxicity reference value for this endpoint (i.e., Category D: not classifiable as to human carcinogenicity). The U.S. EPA indicate that they have established a chronic oral reference dose (RfD) for phenol based on decreased maternal weight gain from a rat developmental study (U.S. EPA, 2002). The U.S. EPA's Region 9 have established an preliminary remediation goal (PRG) for soil based on the non-carcinogenic effects related to exposure to phenol at 1.8×10^4 µg/g (U.S. EPA Region 9, 2002). The Ontario Ministry of the Environment's Soil and Groundwater Standards for phenol are listed as 40 µg/g and 4200 µg/L, respectively (MOE 2004).

3.2 MOE Research Component

There is a significant concentration of acrylamide polymer in PFB. There is a small amount of acrylamide monomer in this material that could leach into groundwater. The detection limit for acrylamide monomer initially used by the MOE (0.30 ug/L) was above the U. S. EPA Region 9 PRG for acrylamide in drinking water (0.015 ug/L). The MOE now has the capacity to measure

acrylamide monomer with a detection limit of 0.010 ug/L. The Expert Panel felt that this concern should be followed by the MOE and that sampling should be undertaken on a research basis by the MOE rather than a regulatory requirement put on berm users.

There is currently no reliable detection method available to characterize potential exposure to MEK. The MOE should develop such methods. There is the potential for greater concentrations of phenols to leach from the berms as they mature. The MOE should sample for MEK and total phenols in the monitoring wells at berm sites to determine whether these compounds might present a risk to human health or the environment.

4.0 Algorithm for the Use of PFBs in Berms at Gun Clubs

4.1 General Principles of the Algorithm for Sound-Sorb Berm Management

The Expert Panel believes that in principle, the recycling of materials such as PFB presents a favorable use of a biosolid as an alternative to landfilling, but the recycling and reusing waste materials must have very low risk for adverse effects on the environment. The Panel felt that such a policy was appropriate for PFB mixed with mineral soil if the following conditions were met:

- The reuse of the PFB was subject to a strict monitoring regime/protocol;
- Hydrogeological assessments of existing Sound-Sorb berms must be conducted to ensure that the environment is adequately protected in these cases (already done for OSGC);
- Any new construction of berms using Sound-Sorb was controlled by MOE regulation;
- The algorithm developed must distinguish between existing berms and proposed development of new berms.
- Any algorithm for the use of Sound-Sorb to create new berms require that the PFBs be composted prior to use in making Sound-Sorb.

The algorithm described below can also be found represented schematically in Figure 1 (p. 33).

4.1.1 Sensitive Sites

Before a berm can be constructed at a new site, determination must be made if the site is sensitive as defined in this section. If the area is sensitive, a berm cannot be constructed. An area is defined as sensitive if:

- it is adjacent or within an area of natural significance including those areas as defined in Section 41(3) of the Records of Site Condition (RSC Regulation) – O. Reg. 153/04.
- it is adjacent to or 30 meters from a water body.
- it were to be constructed on shallow soil property. Shallow soil is defined here as where $^{1}/3$ or more of the area of the property consists of soil equal to or less than 2 metres in depth to rock or bedrock.

4.2 Hydrogeological Assessment

Paper fibre biosolids should only be used in berms at gun clubs under a Certificate of Approval from the Ministry of the Environment. In order to apply for a Certificate of Approval the proponent for a new berm should engage the services of an APGO-certified hydrogeologist to assess the proposed site. The hydrogeological assessment should determine:

- Whether or not it is a sensitive site as set out in Section 4.1.1.

- Whether or not the site is or is likely to be controlled under watershed protection legislation;
- Potential pathways for runoff from the proposed berm(s) to reach surface water;
- Existing information on soils, bedrock and groundwater at the site with respect to the potential for contaminants to reach human and environmental receptors;
- Sufficient wells will be drilled and samples taken by a qualified person that are required for assessing the site;
- Locations for additional monitoring wells may be proposed to further establish direction of groundwater flow, assess upstream and downstream chemical parameters in the groundwater, detect leachate contamination of the groundwater, and impact of leachate off-site.

The hydrogeologist may recommend and/or the MOE may require more extensive hydrogeological assessment or a full SSRA to characterize potential pathways of contaminants to human and environmental receptors before a Certificate of Approval is issued.

4.3 Certificate of Approval

The MOE should not issue a certificate of approval for sensitive sites or sites controlled against such use by watershed protection legislation. The Certificate of Approval shall cover:

- The materials that may be used;
- Construction and maintenance of the berm;
- A groundwater monitoring program;
- A requirement to allow the MOE access to the monitoring wells to conduct research;
- Other conditions the MOE may require.

The MOE may choose to use legal instruments that provide equal or better protection than Certificates of Approval to control these berms.

4.4 Materials for use in Berm Construction

Berms constructed at gun clubs that include PFB shall contain **only** the following materials:

- Paper fibre biosilids composted according to the recently amended Ontario MOE Composting Guidelines (MOE May 2004) at a site controlled by a Certificate of Approval.
- Uncontaminated mineral soil as needed to construct a stable berm. This material will be well mixed with the composted PFB;
- Other organic compost intended to support the growth of the vegetative cover. This compost shall be provided only from sources in compliance with the Ontario MOE Composting Guidelines (MOE May 2004).

The PFB should be transported to the composting site unmixed with other materials as a waste. The composted PFB for any bulk use should remain under regulatory control.

4.5 Construction and Maintenance

The Certificate of Approval should set out proper procedures for the construction and maintenance of berms. As a minimum these should include:

- Measures to prevent erosion of the berm material by wind or rain during the construction period;
- Installation of any additional monitoring wells prior to completion of berm construction;
- A requirement to provide vegetated cover and maintain it if additional material is added to the berm;
- A requirement to repair fissures in the berm should they develop;
- A requirement for a survey of and a report to the MOE on the condition of the berm at least four times a year.
- Berms should contain at least 30 percent mineral soil that is well-mixed with the PFBs in order to ensure structural stability.

4.6 Monitoring Program

Paper waste releases significant quantities of chloride into leachate as it decomposes. The berm site should be initially monitored for chloride leachate in the spring and the fall in at least one upstream well and sufficient downstream wells (two or more) to detect when the early leachate reaches groundwater. Paper fibre biosolids have high concentrations of chloride. This chloride is highly mobile and most of it will leach out of the berms in the first few years.

The average concentration of chloride ions in the Atlantic Packaging paper fibre sludge from the Whitby Plant bunker, sampled in October 2001, was 135 mg kg^{-1}. Samples of soil taken from the Sound-Sorb berm at the Oshawa Gun and Skeet Club at 45-65 cm depth and at 50-100 cm contained 540 and 880 mg kg^{-1} of chloride, respectively. Concentrations of chloride in background soils in the same location were approximately 3 mg kg^{-1}. This data clearly indicates that chloride ions are moving down in the berm and will eventually reach the monitoring wells. As there are few, if any, impediments to the movement of chloride ions in soils and sediments, it is to be expected that the appearance of increased chloride ions in the monitoring wells would indicate the arrival into the wells of leachate water from the Sound-Sorb berm. As other possible contaminants would arrive at a later time, the appearance of chloride ions in the well waters should trigger the monitoring of lead, PAHs, TPH, pH and BOD in all subsequent well-water analyses.

It could be argued that, like other composts, the composted PFB should no longer require MOE and monitoring. However the bulk use of composted PFBs presents several concerns:

- the composting process is not complete at the point the Ontario Composting Guidelines

would be met;

- depending on environmental conditions where berms were constructed the further decomposition could become acidic and generate an acid leachate;
- the use of composted PFBs in berms concentrates large quantities of the material in one location.
- The sites where Sound-Sorb has been used have a potential for soil contamination by the historic use of lead.

In the first year a baseline determination (spring and fall) of lead, PAHs including benzo (a) pyrene, TPH, pH and BOD will be made. These parameters should also be monitored at least twice a year (spring and fall) once chloride leachate has impacted the groundwater. Testing for chloride may then be discontinued. All testing should be done at a laboratory accredited for the purpose. Testing should continue in perpetuity as long as the berm has an impact on the site. The parameters to be tested for are: lead, PAHs including Benzo(a)pyrene, TPH, pH and BOD. Testing for pH is included as a simple measure to assess the decomposition in the berm. A highly acid pH without increases in lead or other metal contaminants may indicate that the berm sits on clean soil. Much of the groundwater at shallow depths enters surface waters within a short period of time. BOD should therefore be part of the monitoring program.

All sampling under the monitoring program should be done by a qualified individual.

4.7 Remediation

Lead and benzo(a)pyrene levels should be compared with the Ontario Drinking-Water Quality Standards. If the ODWS standard for either of these substances is exceeded for groundwater leaving the site, the MOE should take measures to mitigate the risk of contamination of offsite groundwater. These measures could include:

- Confirmatory or other further study
- SSRA or other risk assessment
- Removal of the berm
- Lifting the berm and installing a leachate collection system
- Removal of contaminated soil

4.8 Management of Existing Berms

A hydrogeological assessment as described in Section 4.2 should be done. The Panel felt that the investigations already done at the OSGC site meet this requirement. Monitoring wells should be drilled and the baseline parameters measured as outlined in Section 4.6 in the spring and fall.

If the baseline assessment shows the potential for lead or benzo(a)pyrene to move off-site, the MOE should take remedial measures as set out in Section 4.7.

If the site conditions determined by the hydrogeological assessment are satisfactory, the MOE should issue a Certificate of Approval that:

- Limits additions of PFB to the berm for repair to composted PFB;
- Requires an on-going maintenance program as set out in Section 4.5;
- Requires an on-going monitoring program as set out in Section 4.6;

The MOE should take mitigative measures as set out in Section 4.7 if on-going monitoring reveals the potential for lead or benzo(a)pyrene to move off-site.

4.9 Caveats on Application of the Algorithm

This algorithm relates only to the paper fibre biosolids produced by Atlantic Packaging at its Whitby and Scarborough operations. The data available to the Panel was on PFB from Atlantic Packaging and its historical use in Sound-Sorb in a number of berms at gun clubs, primarily OSGC. The Panel therefore could only come to conclusion with respect to the use of PFBs from this source when then are mixed with clean mineral soil. The Panel's conclusions do not apply to PFBs if there is a difference in composition that is likely to increase the risk to human or environmental health. This difference could come from either the feedstock or the process chemicals. Any generalizations drawn from these conclusions depend on evidence that indicates a greater or lesser risk from other materials.
The information that the Expert Panel reviewed applied to berms constructed at gun clubs. The MOE should consider these principles for berms constructed at other locations.

5.0 Answers to the Three Questions

5.1 Question 1: Does Sound-Sorb, as used as a berm construction material, present a risk to human health or the environment and what is the nature of that risk?

The Expert Panel felt that it could not come to a conclusion on all of the possible risks to human health and the environment based on the data it had. It also felt that a more systematic collection of data at berms would not provide a comprenensive assessment of the risks. On the other hand the Expert Panel believed that the bulk use of PFB in berms could be managed in a way that would reduce any risk to human health and the environment to a minimum. The Expert Panel came to the conclusion that this material could with proper regulatory control be used to construct berms without causing an unacceptable risk to human health or the environment.

5.1.1 Recommendation

The Expert Panel therefore recommends that:

1. There is no need to ban the use of PFB mixed with mineral soil (Sound-Sorb) for bulk use in berms.

5.2 Question 2: If yes, to what degree and what management measures, if any, can be instituted to eliminate or minimize the risks to acceptable levels?

The berm at the OSGC has not been in place long enough for significant leachate to reach the monitoring wells. The berm also have not been in place long enough to determine the risk for anaerobic decomposition of the material that would render the leachate more acidic. No evaluation had been done of possible soil contamination at the site where the berms were located. The Expert Panel believes that there is a potential for anaerobic decomposition of the PFBs in Sound-Sorb material creating an acid leachate. Because of the historical use of lead on gun club sites there was a possible risk of mobilization of lead from soil beneath berms. The high level of organic material in the berms also presented a risk of elevated biological oxygen demand (BOD) for surface water receptors at sensitive sites.

5.2.1 Recommendations

The Expert Panel therefore recommends that:

2. There is no need to remove the OSGC berm provided long-term monitoring of the groundwater is continued.

3. Existing berms at other gun clubs should have a hydrogeological assessment. A monitoring regime in accord with the algorithm found in Chapter 4 should be established. Removal of a berm would only be appropriate as a mitigation option if contaminants in excess of the Ontario Drinking-Water Quality Standards were found in groundwater leaving the site or significant risks to human or environmental health were found on an SSRA or other risk assessment.

The Expert Panel came to the conclusion that PFBs before being used as a berm construction material should be composted for the following reasons:

- the anecdotal reports from several Tier 2 members indicated that Sound-Sorb when it was initially used in a berm generated enough heat to prevent the growth of vegetation for one growing season even when a layer of compost was applied on top;
- concern had been raised by Tier 2 that E. coli had been found and pathogenic organisms were potentially present in PFBs;
- TPH was the only COPC in excess of Table 1 criteria in the PFBs. The specific TPHs would to some extent biodegradable in a composting process.

The uncertainties with respect to these concerns could be alleviated by composting. The recently amended Ontario Composting Guidelines (MOE May 2004) are adequate for this purpose and should be applied.

5.2.2 Recommendation

The Expert Panel therefore recommends that:

4. PFB should be composted before its use in a berm.

It could be argued that, like other composts, the composted PFB should no longer be considered a waste. However the bulk use of composted PFBs presents several concerns:

- the composting process is not complete at the point the Ontario Composting Guidelines would be met;
- depending on environmental conditions where berms were constructed the further decomposition could become acidic and generate an acid leachate;
- the use of composted PFBs in berms concentrates large quantities of the material in one location.

The sites where Sound-Sorb has been used have a potential for soil contamination by the historic use of lead.

The Expert Panel believed that site-specific factors therefore were relevant to the safety of the use of this material in bulk and that the site locations where it was used should be regulated. The Panel felt that monitoring the site was an efficient way to manage this use, both with respect to costs and reassurance to the community.

5.2.3 Recommendation

The Expert Panel therefore recommends that:

5. Before a berm constructed of PFB and mineral soil is placed at any new location, a hydrogeological assessment should be done, and a SSRA done if the assessment indicates that one is necessary according to algorithm found in Chapter 4. The use of the proposed site for a new berm should be subject to MOE control by a Certificate of Approval or legal instrument that provides equal or better protection for human health and the environment.

5.3 Question 3: Given the intent to apply the findings across the Province, under what conditions should Sound-Sorb not be used or its use restricted?

5.3.1 Caveats Regarding the Conclusions

The Expert Panel noted that according to current regulation the existing berms could contain wastes other than PFBs. To the Panel's knowledge, none of the sites where existing berms are located had been assessed for possible contamination of the soil at the site before the berm had been constructed. These considerations reinforce the need for monitoring groundwater wells around the existing berms in perpetuity. The Panel recommends that monitoring wells be used for new berms as well because information on the potential leachate from mature berms is not available. The Panel does not exclude the possibility that extensive further study of the PFB material and a thorough assessment of the hydrogeological situation at a particular site might provide sufficient evidence for the MOE to permit the use of the PFB material at a specific site without monitoring wells.

The Expert Panel recognizes that the berms are likely to be covered with a thin layer of compost from yard waste/green box sources to assist vegetation of the berms. The Panel did not have data on the composition of and did not come to any conclusion with respect to the actual compost used at OSGC. Such compost should meet MOE composting guidelines.

The Experts Panel did not come to any conclusions with respect to the safety of PFB for application to agricultural land (composted or not composted) with regard to human health, environmental or agricultural criteria. There are five current uses of PFB onto land in Ontario:

- As a soil amendment on agricultural land;
- In land reclamation in the Welland area;
- As a soil mulch in the horticultural industry;
- As a component in Nitro-sorb, where it is mixed with composted leaf and yard waste;
- As a component of seed bedding materials in the nursery industry.

The MOE may choose to use legal instruments equivalent or better than Certificates of Approval. The recommendations set out minimum requirements. The MOE may add additional requirements as it sees fit as new information becomes available. Under the management algorithm proposed here the MOE could require, based on its own investigations, monitoring for

other substances for which evidence exists or becomes available.

Paper fibre biosolids are a waste. Their bulk use in the environment even after composting requires regulatory control. Paper fiber biosolids are used in a number of other bulk applications for land application mixed with compost or as a sole soil amendment. The Terms of Reference for the Expert Panel did not include these uses. The Panel felt that Sound-Sorb should not be used in an uncontrolled manner as an exempt waste as it is at present. The Panel believes that regulatory instruments that would control Sound-Sorb in its use in berms should provides the means to exert the regulatory control that the MOE may deem appropriate for other bulk uses of PFB.

5.3.2 Recommendation

The Expert Panel therefore recommends that:

6. Paper fibre biosolids should be controlled by Certificates of Approval or legal instruments that provide equal or better protection for human health and the environment at all stages from its generation through transport, composting and final use in the construction of berms. The use of paper fibre biosolid material mixed with mineral soil should also be subject to MOE control with respect to its preparation and use in the environment by a Certificate of Approval or legal instrument that provides equal or better protection for human health and the environment.

6.0 Recommendations

1. There is no need to ban the use of PFB mixed with mineral soil (Sound-Sorb) for bulk use in berms.

2. There is no need to remove the OSGC berm provided long-term monitoring of the groundwater is continued.

3. Existing berms at other gun clubs should have a hydrogeological assessment. A monitoring regime in accord with the algorithm found in Chapter 4 should be established. Removal of a berm would only be appropriate as a mitigation option if contaminants in excess of the Ontario Drinking-Water Quality Standards were found in groundwater leaving the site or significant risks to human or environmental health were found on an SSRA or other risk assessment.

4. PFB should be composted before it is used in a berm.

5. Before a berm constructed of PFB and mineral soil is placed at any new location, a hydrogeological assessment should be done, and a SSRA done if the assessment indicates that one is necessary according to algorithm found in Chapter 4. The use of the proposed site for a new berm should be subject to MOE control by a Certificate of Approval or legal instrument that provides equal or better protection for human health and the environment.

6. Paper fibre biosolids should be controlled by Certificates of Approval or legal instruments that provide equal or better protection for human health and the environment at all stages from its generation, through transport, composting and final use in the construction of berms. The use of paper fibre biosolid material mixed with mineral soil should also be subject to MOE control with respect to its preparation and use in the environment by a Certificate of Approval or legal instrument that provides equal or better protection for human health and the environment.

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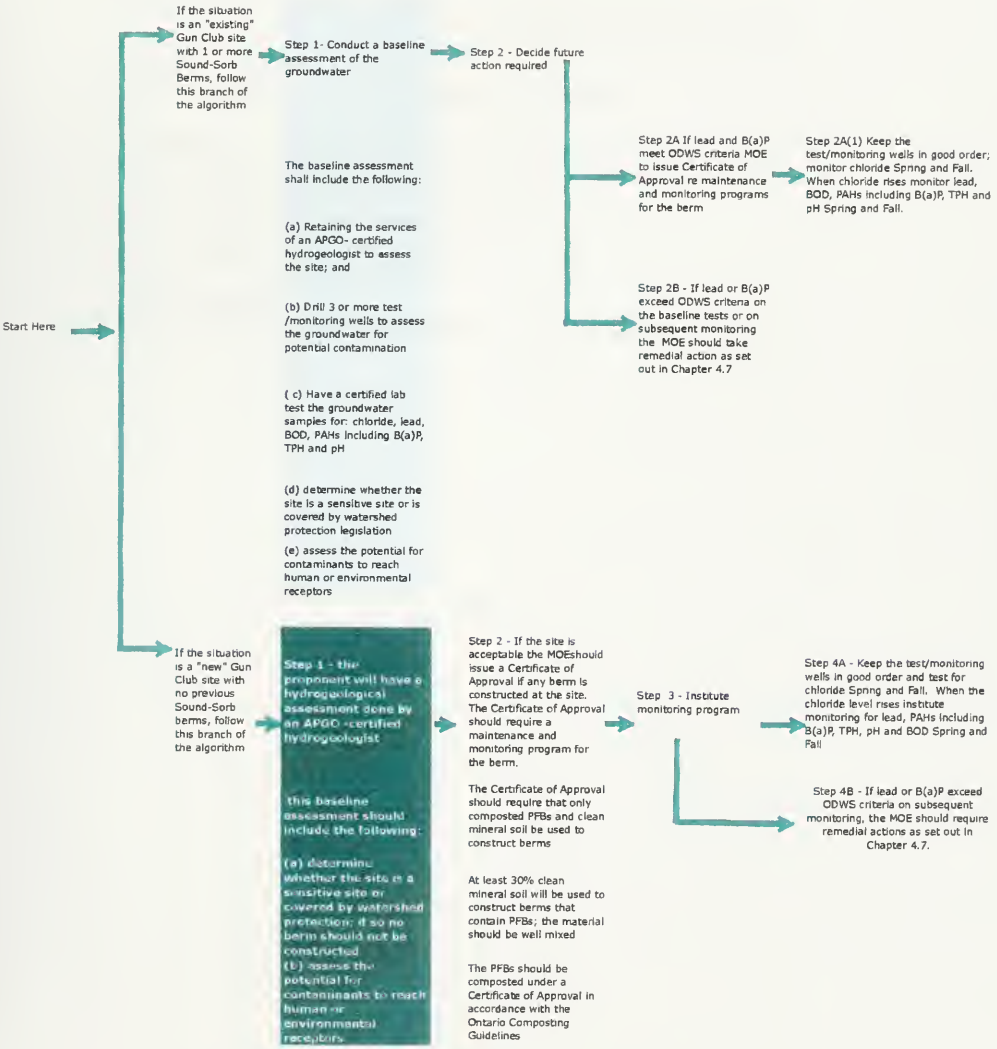
Start Here
If the situation is an "existing" Gun Club site with 1 or more Sound-Sorb Berms, follow this branch of the algorithm
Step 1- Conduct a baseline assessment of the groundwater
Step 2 - Decide future action required
The baseline assessment shall include the following:
(a) Retaining the services of an APGO- certified hydrogeologist to assess the site; and
(b) Drill 3 or more test /monitoring wells to assess the groundwater for potential contamination
(c) Have a certified lab test the groundwater samples for: chloride, lead, BOD, PAHs including B(a)P, TPH and pH
(d) determine whether the site is a sensitive site or is covered by watershed protection legislation
(e) assess the potential for contaminants to reach human or environmental receptors
Step 2A If lead and B(a)P meet ODWS criteria MOE to issue Certificate of Approval re maintenance and monitoring programs for the berm
Step 2A(1) Keep the test/monitoring wells in good order; monitor chloride Spring and Fall. When chloride rises monitor lead, BOD, PAHs including B(a)P, TPH and pH Spring and Fall.
Step 2B - If lead or B(a)P exceed ODWS criteria on the baseline tests or on subsequent monitoring the MOE should take remedial action as set out in Chapter 4.7
If the situation is a "new" Gun Club site with no previous Sound-Sorb berms, follow this branch of the algorithm
Step 1 - the proponent will have a hydrogeological assessment done by an APGO -certified hydrogeologist
this baseline assessment should include the following:
(a) determine whether the site is a sensitive site or covered by watershed protection; if so no berm should not be constructed
(b) assess the potential for contaminants to reach human or environmental receptors
Step 2 - If the site is acceptable the MOEshould issue a Certificate of Approval if any berm is constructed at the site. The Certificate of Approval should require a maintenance and monitoring program for the berm.
The Certificate of Approval should require that only composted PFBs and clean mineral soil be used to construct berms
At least 30% clean mineral soil will be used to construct berms that contain PFBs; the material should be well mixed
The PFBs should be composted under a Certificate of Approval in accordance with the Ontario Composting Guidelines
Step 3 - Institute monitoring program
Step 4A - Keep the test/monitoring wells in good order and test for chloride Spring and Fall. When the chloride level rises institute monitoring for lead, PAHs including B(a)P, TPH, pH and BOD Spring and Fall
Step 4B - If lead or B(a)P exceed ODWS criteria on subsequent monitoring, the MOE should require remedial actions as set out in Chapter 4.7.

Appendix A Tier 1 Members

- **HUMAN HEALTH EFFECTS**
  Dr. Brian Gibson - Ministry of Health
  Dr. Lesbia Smith - Toxicology - Assistant Professor of Public Health Sciences

- **HYDROGEOLOGIST**
  Bill Blackport, M.Sc., P. Geo. -Hydrogeologic Consultant

- **GROUNDWATER**
  Dr. Les Evans –groundwater chemistry and soils -University of Guelph

- **TOTAL PETROLEUM HYDROCARBONS (TPH)**
  Dr. Merv Fingas - Environment Canada-

- **RISK MANAGEMENT**
  Mark Chappel - Risk Assessment Specialist - AMEC Earth & Environmental

Appendix B Tier 2 - Affected Stakeholders

- **ATLANTIC PACKAGING**
  Todd Kostal
  Nancy Downs(Alternate)

- **COURTICE AUTO WRECKERS**
  Harvey Ambrose

- **OSHAWA SKEET AND GUN CLUB**
  Jim Anderson
  Bob Cake (Alternate)

- **PROTECT THE RIDGES**
  Deb Vice
  David Wade - Environmental Risk Manager and Geoscientist

- **BROCK LAND STEWARDS**
  Don Whitcombe

- **SIERRA CLUB OF CANADA**
  Maureen Reilly

- **CITY OF OSHAWA**
  Warren Munro

- **MUNICIPALITY OF CLARINGTON**
  Faye Langmaid

- **DURHAM REGION - HEALTH & SOCIAL SERVICES COMMITTEE**
  John Neal - Chair and Regional Councillor from Oshawa (Alternate: Ken Gorman)
  Margo McNab

- **ASSOCIATION OF GUN CLUBS**
  Canadian Shooting Sports Association (John Simpson)

Appendix C

Table C.1 Synopsis of the Conclusions of the 13 Key Reports

Table C1 Synopsis of the Conclusions of the 13 Key Reports

Report Name/Author	Location of Sound Sorb Berm	Potential for the berms to be anaerobic	Does Sound-Sorb as used as berm construction material, present a risk to human health or the environment and what is the nature of that risk?	If yes, to what degree and what managemeot measures, if any, can be instituted to eliminate or minimize the risks to acceptable levels?	Given the intent to apply the findings across the Province, under what conditions should Sound-Sorb not be used or its use restricted?	Notes/Comments
CANTOX 2004	Oshawa	NO	NO	-	-	-
MOE April 2004	Oshawa	NO	NO	-	-	-
MOE June 2004	Flamborough	NO	YES	Cease transportation of material and remvoe material and contam/control material	Near ESAs	Discusses turbidity
ZCG Waste Mgmt April 2000	Scarborough/Whitby	NO	NO	-	-	Measures microrganisms and bacteria.
Gartner Lee July 2001	Oshawa	NO	NO	-	-	E-coli linked to human/animal sewerage
MOE August 2001	Clarington	NO	NO	-	-	Metals not linked to Sound-Sorb
MOE September 2001	Oshawa and Clarington	NO	NO	-	-	Groundwater monitoring recommendations.
MOE June 2002	Oshawa	NO	NO	-	-	SSRA, Groundwater and VOC testing of soil
MOE January 2003	Aylmer	NO	NO	-	-	do SSRA
GlobalTox March 2003	Oshawa	NO	NO	-	-	Develop criteria for acrylamide
MOE August 2003	Oshawa	NO	NO	-	-	-
MOE January 2004a	Orillia	NO	NO	-	-	Studies confirmed that berms with Sound-Sorb display a similar pattern of compounds detected.
MOE January 2004b	Madoc	NO	NO	-	-	Studies confirmed that berms with Sound-Sorb display a similar pattern of compounds detected.

Note: Contents of this matrix is interpreted from individual report. This is not the opinion nor the conclusion of AMEC's findings.

Appendix D

Table D.1 Summary of Findings from the Draft SSRA CANTOX (May 2004)

Table D1 Summary of Findings from Draft SSRA Cantox (May 2004)

What are the substances/issues of concern?	Was a screening criteria/methods Used in the Study/Report (e.g., Generic Criteria?)	Was this Parameter Considered Worthy of detailed investigation?	Is there a potential impact on fish habitat (aquatic)?	Is there a potential for leaching and impact on groundwater and surface water?	Has the parameter been tested on the site?
E. coli	YES	NO	NO	NO	YES
Acrylamide Monomer	YES	NO	NO	NO	YES
Total Petroleum Hydrocarbons (TPH)	YES	YES	NO	NO	YES
Temperature	NO	NO	NO	NO	NO
PAH's	YES	NO	NO	NO	YES
Surfactants- Nonylphenol and nonylphenol ethoxylates	YES	NO	NO	NO	YES
VOC's [Toluene, methyl ethyl ketone (MEK)]	YES	NO	NO	NO	YES
Bioaersols	NO	NO	NO	NO	NO
Metals (copper, lead, silver) in the groundwater and surface water	YES - Groundwater	NO	NO	NO	YES - Groundwater
Nutrients		NO	NO	NO	
BOD and COD	NO	NO	NO	NO	NO
Pesticides		NO	NO	NO	
Arsenic	YES	YES	NO	NO	YES
Formaldehyde	NO	NO	NO	NO	NO
PCB's	YES	NO	NO	NO	YES
Compounds likely to be found in inks, dyes, laser jet ink	NO	NO	NO	NO	NO
Compounds from drinking boxes	NO	NO	NO	NO	NO
Waxes and wax solvents	NO	NO	NO	NO	NO

Note Contents of this matrix is interpreted from individual report This is not the opinion nor the conclusion of AMEC's findings

Appendix E References from the Binder of Reports

April 2000 - Atlantic Packaging
Microbiological analysis of fresh, stockpiled and land applied bulk fibre biosolids (PFB) samples

April 27, 2001 – Environment Canada
Aquatic Toxicity Test Report- Madoc Gun Club

July 30, 2001 - Gartner Lee Limited to Health Dept of Durham Region
Re: Sampling and Analysis of Paper Sludge at Oshawa Skeet and Gun Club

August 24, 2001 - Memo from Peter Balaban to Distribution List
Re: Lab analysis Summary of Soil and Water Samples taken at Concession 10, Municipality of Clarington

Sept 27, 2001 - Memo to Peter Balaban from Deborah Conrod - Hydrogeologist MOE
Re: Selection of Groundwater Monitoring Locations for the Three Sites in Oshawa and Darlington Townships (Town of Clarington), Regional Municipality of Durham; that either presently have or may have had in the past, Paper Sludge and/or Sound-Sorb (Paper Sludge-Sand Mixture) Stored On-Site

October 25, 2001 – Memo to Peter Balaban from Deborah Conrod
Status Up-date on Groundwater Monitoring Locations

June 20, 2002 - Memo from Peter Balaban to Distribution List
Re: Report on the Results of Chemical and Microbiological Testing of Atlantic Packaging Paper Fibre Biosolids and the Sound- Sorb Berm, Oshawa Skeet and Gun Club

June, 2002 - Public Meeting Slides
Atlantic Packaging Ltd. Paper Fibre Biosolids and Sound-Sorb Berm, Oshawa Skeet and Gun Club: Results of Chemical and Microbiological Testing

January, 2003 – Report
"Chemical and Microbiological Test Results of Sound-Sorb Berm at the East Elgin Sportsman's Association, Aylmer, Ontario"

March 11, 2003 – Global Tox
Preliminary Results of Phase 1 Bioaerosol Study at the Oshawa Skeet and Gun Club

March 31, 2003 - MOE's Review of Sound – Sorb
Report on the EBR Application for Review -EBRO File # - 01EBR008.R

May 16, 2003 – Environment Canada
Aquatic Toxicity Test Report- East Elgin Sportsman's Association

Aug 5, 2003 - Memo from Peter Balaban to Distribution List
Re: Groundwater Impact Study Results of Sweep 1- Results of the first sweep of groundwater monitoring from the test wells located at the Oshawa Skeet and Gun Club, Harmony Road Composting Site and the Ambrose Aggregate Pit.

September 2003 – Health Department
Ministry of the Environment Split Sample PAH Survey

Jan 12, 2004 - Memo from Peter Balaban to Distribution List
Re: Chemical and Microbiological Test Results of Sound-Sorb Berm at the Orillia Gun Club; Chemical and Microbiological Test Results of Sound-Sorb Berm at the Madoc and district Anglers and Hunters Site; and Atlantic Packaging Ltd. Paper Fibre Biosolids Regulation 347 Waste Classification

February 13, 2004 –
Revised Final Report Oshawa Skeet & Gun Club Phase I Bioaerosol Study

February 2004 – Ministry of the Environment
Chemical and Microbiological Test Results of Sound-Sorb Groundwater Impact Study at the Oshawa Skeet and Gun Club Sweep 2

April 2004 – Ministry of the Environment
Chemical and Microbiological Test Results of Sound-Sorb Groundwater Impact Study at the Oshawa Skeet and Gun Club Sweep 3

June 16, 2004- Ministry of the Environment
Flamborough Package

July 12, 2004- Ministry of the Environment
Draft SSRA for the OSGC

August 23, 2004- Letter from Gartner Lee Limited to Health Department of Durham Region
Sampling and Analysis of Paper Sludge at OSGC

Additional Information

February 1997- Ministry of the Environment
Guideline for Use at Contaminated Sites in Ontario January 2004 – Oshawa

February 2004 – Sound-Sorb Berm at the Oshawa Skeet and Gun Club Groundwater Impact Study Well Installation and Development

Skeet and Gun Club Groundwater Impact Study Well Development and Sample Collection Protocols

Oshawa Skeet and Gun Club Wells- Sampling Instructions

Appendix F Literature Searches

2001
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Extractable soil heavy metals following the cessation of biosolids application to agricultural soil. Environ Pollut 1172: 315-21.

Watanabe T, Sano D, Omura T., 2002
Risk evaluation for pathogenic bacteria and viruses in sewage sludge compost. Water science and technology: a journal of the International Association on Water Pollution Research 46: 325-330.

Appendix G List of Submissions

September 29, 1999- Maureen Reilly
Letter to Honorable Tony Clement

September 13, 2001- Soil Resource Group
Peer Scientific Review of : "Paper Fibre Biosoilds (PFB) Benefits Study"

January 23, 2002- Aylmer Express
Gun Club barrier construction starts

September 29, 2003- Council of the Municipality of Clarington
Clarington Resolution

December 4, 2003- Association of Local Public Health Agencies
Association of Local Public Health Agencies Resolution A01-14- Paper Fibre Biosolids Disposal

February 25, 2004- Sludge Watch
Lab fined $5M for faking reports water, soil, drug results

March 5, 2004- Maureen Reilly
Polymer used is AP sludge- Cytek Superfloc 45

March 14, 2004- Maureen Reilly
List of Sound-Sorb and Paper Sludge Analytical Data

March 19, 2004- Sludge Watch
Firm told to remove sludge

April 3, 2004- Sludge Watch
Gun club rift over waste use

April 10, 2004- Maureen Reilly
Cytek Superfloc: Source of some of the petroleum and acrylamide

May 6, 2004- Township of Malahide
Malahide Resolution

May 8, 2004- Ministry of the Environment
TPH Characterization Data

May 17, 2004- Ministry of the Environment
Bioaerosol Committee minutes

May 20, 2004- Premier Environmental
Memo- Groundwater Sampling

May 20, 2004- Atlantic Packaging
MSDS Sheets and Additional

May 21, 2004- Deb Vice
Order against Courtice

May 21, 2004- Deb Vice
New Flamborough Order

May 24, 2004- Chris Dancey
Sound-Sorb/PFB removal orders for Expert Panel

May 25, 2004- Backstreet Consultants
Berm Construction Sequence

May 31, 2004- Atlantic Packaging Letter
TPH Results for Atlantic Packaging's paper biosolids

June 1, 2004- Ministry of the Environment
OSGC Elevations

June 12, 2004- William Clark
Emailed Photos of the Orillia Gun Club

July 6, 2004- Ministry of the Environment
Rationale List

July 20, 2004- JFM Environmental Limited
Response to Ministry of Environment Technical Support Staff 1406 Gore Road, Hamilton

July 28, 2004- JFM Environmental Limited
Groundwater Sampling and Monitoring Program 1406 Gore Road, Hamilton

August 1, 2004- JFM Environmental Limited
Assessment of Environmental Impact from Courtice Fill Placement 1406 Gore Road, Hamilton

September 30, 2004- JFM Environmental Limited
Groundwater Monitoring Report 1406 Gore Road, Hamilton

October 7, 2004- Maureen Reilly
Evaluating the risks posed by Sound-Sorb

October 19, 2004- William Clark
Notes from the meeting with William Clark including photos

October 23, 2004- John Simpson
Memo- Installation of Wells and Testing of Water at Sound-Sorb sites

November 29, 2004- Maureen Reilly
Submission to the Experts Panel

November 30, 2004- Protect the Ridges
Submission to the Experts Panel

November 30, 2004- Marilyn Beattie, Riversite Farm
Letter to the Experts Panel

November 30, 2004- Margo McNab
Submission to the Experts Panel

December 1, 2004- John Neal
Memo- Tracking of Trucks hauling and distributing Sound-Sorb

December 11, 2004- Oshawa This Week
Region pushes Province to act on Sound-Sorb concerns

December 13, 2004- Oshawa Skeet and Gun Club
Letter to the Experts Panel

December 20, 2004- Sludge Watch
Sludge dumper fined Courtice ordered to pay $10,000 for violating fill regulations